SB761
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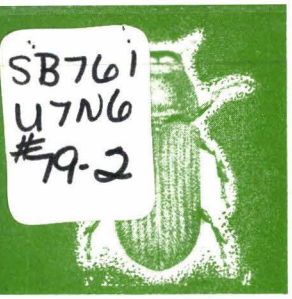
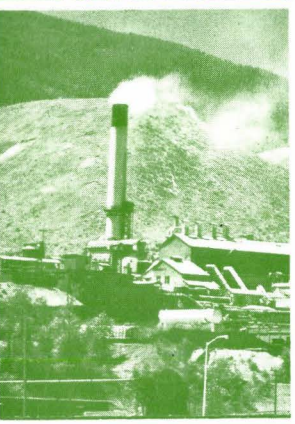
#79-2





FOREST INSECT & DISEASE MANAGEMENT

USDA · FOREST SERVICE · NORTHERN REGION

State & Private Forestry · Missoula, MT 59801

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3450
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R-1 FOREST INSECT AND DISEASE DAMAGE SURVEY SYSTEM

By

Wayne E. Bousfield, Entomologist

INTRODUCTION

The purpose of insect and disease damage surveys is to estimate losses caused by various pests so that the land manager can prescribe appropriate management action.

Systematic ground data collection systems provide to the land manager loss data that can be used for cost benefit analysis, management plans, environmental impact statements, and for projecting losses at a forest level. The survey data could be integrated into timber management plans to fill voids in stand models to predict losses. This handbook describes field data collection procedures and data recording necessary to operate the supporting computer program "INDIDS" (Insect and Disease Damage Survey).

SURVEY TYPES

Usually, the land manager has only one specific pest in mind when conducting loss surveys. This system, however, provides for four specific pest types: (1) Bark beetles, (2) defoliators, (3) disease, (4) noninfectious disease. Data can be collected for all four types at the same time if desired, but analyzed separately using the computer program "INDIDS" for the different options. The program provides detailed mensurational data of stands by species, size class, and damage class of designated survey type and aggregates other problems in one column. Detailed statistics on other problems can be obtained by running the option desired. Each sample tree in the survey, however, is limited to three pest problems or severity.

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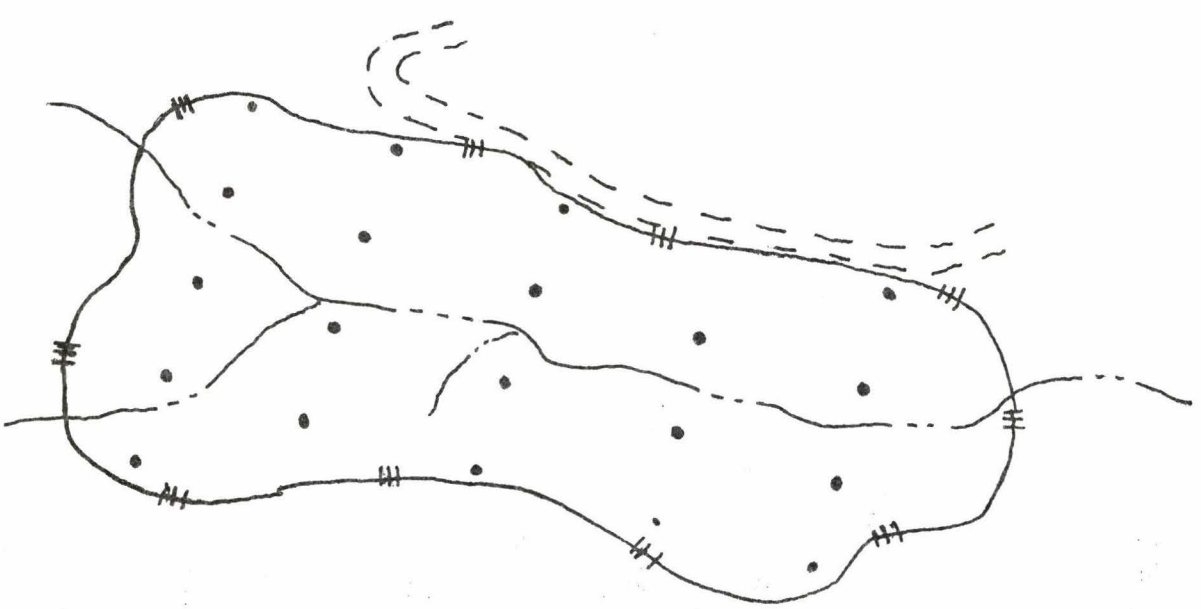
For example, a tree could be attacked by bark beetles, have mistletoe, and be top killed by a defoliator. Another tree could be recorded as having moderate defoliation, be lightly top killed, and have root rot. This flexibility allows for several alternatives in data collection and four options to summarize detailed statistics.

Periodic annual increment is also an option. If growth loss estimates caused by a defoliator are desired and the stand recently became infested, then radial growth measurements covering the period during the infestation and prior to the infestation are measured, and adjusted mean growth between host and nonhost trees is tested by covariance analysis. If differences are significant, expected periodic annual increment is computed. Areas of chronic defoliation cannot be evaluated in this manner.

FIELD PROCEDURES

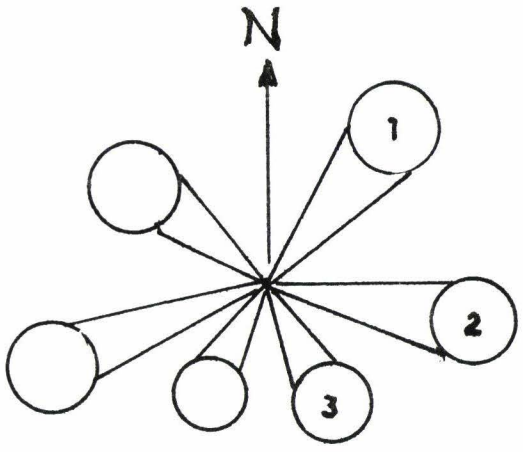
Areas examined must first be delineated into stands using standard photo interpretation (P.I.) guides explained in TM handbooks. Use existing stand delineations if the area is National Forest. Obtain either 2-inch or 2.6-inch/mile topographic maps of the area and resource photography to transfer stand boundaries to field maps. Sample points should occur on a 5- by 10-chain grid to sample a stand satisfactorily. Stands less than 40 acres should be sampled with greater intensity depending on desired sampling error. The following diagram shows how plots could be placed in a 100-acre stand.



When conducting bark beetle surveys uninfested tree information need only be taken on a sample of the total plots. However, at least 10 plots in each stand should be sampled for green stand statistics. For example, if a total of 20 plots are planned for the survey then record data on all trees within the plot on the even numbered plots, and on the odd numbered plots, record trees only if bark beetles have attacked or some other damaging agent is involved. Trees with a "0" code are computed using the green tree number of plots to expand the data to a per-acre basis.

Diameters of all trees in the plot are recorded to the nearest one-tenth of an inch. Tree heights are measured to the nearest 1 foot on a sample basis. The first three trees on each plot in clockwise direction (figure 1) are measured for height. Fewer trees can be sampled for height if precise cubic and board foot volume estimates are not necessary.

Figure 1--Height measurements of sample trees

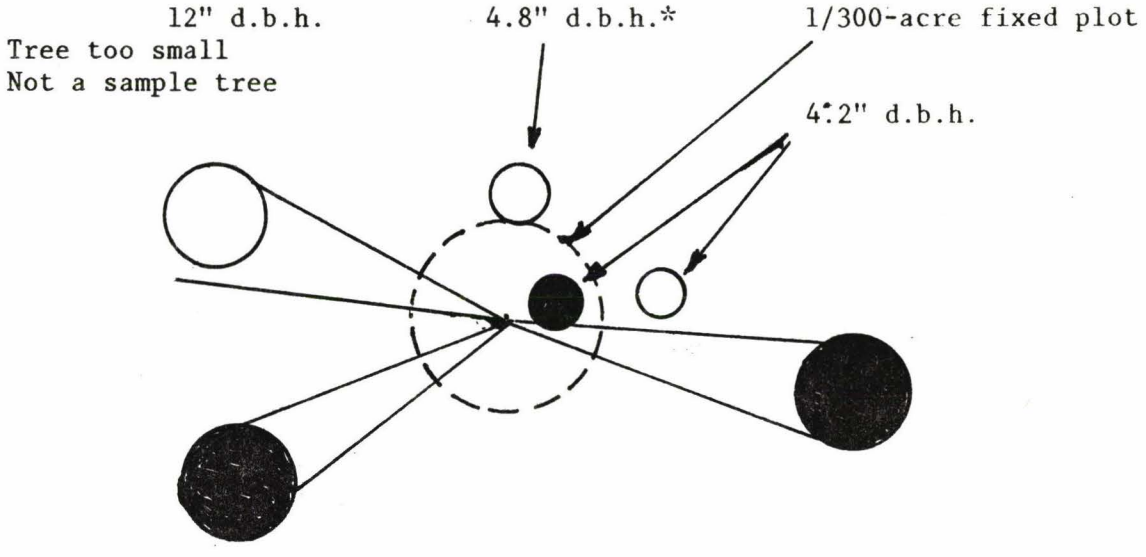


No heights are measured for trees less than 5 inches d.b.h. Regression estimates based on diameters and heights of sample trees are used to obtain heights for unmeasured trees. If periodic increment is desired, then habitat type must be obtained for each plot, and the last 10 years' radial growth measured on each tree that was sampled for height. Ten-year radial growth is measured to nearest 1/10 inch or 1/100 inch if possible. If growth loss is desired in the case of defoliators, then X-year and Y-year growth measurements explained later must be recorded. Douglas-fir, grand fir, subalpine

fir, and spruce will be considered host species. Ponderosa pine, white pine, limber or lodgepole pine will be considered nonhost species for covariance testing. Larch will not be considered because it is a host of budworm and larch casebearer which makes it difficult to determine years infested. If nonhost species are a minor part of the forest, then measure growth of all nonhost trees on the plot.

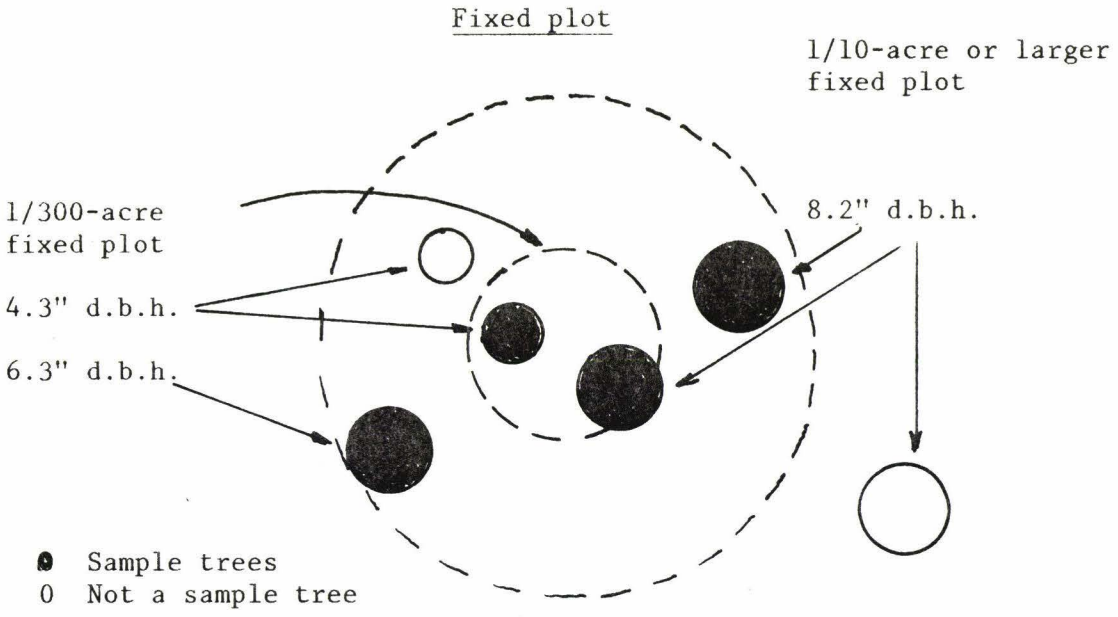
The supporting computer program "INDIDS" will handle both variable and fixed plot sampling. Trees less than 5 inches d.b.h. are only sampled when they occur within a 1/300-acre or 6.8-foot radius fixed plot. A maximum of four best management trees under 5 inches d.b.h. will be recorded on the 300th acre fixed plot. Excess trees are considered culls and will not be recorded. Trees greater than 5 inches d.b.h. are sampled from either variable plot method or fixed plot of 1/10 of an acre or larger plot. The following examples explain sample tree selection.

Variable plot



*Tree in 20 BAF plot but less than 5" d.b.h.

● Sample tree
0 Not a sample tree



RECORDING DATA FOR INDIDS

The following is an explanation of how to record sample tree data on the field data sheet (figure 2).

Identification code: Unique code which identifies header card with data cards--usually the Forest code followed by a number. For example (Ident code 1 0 3 where 10 is the Forest code for Flathead and 3 for that particular stand. This number is used to identify cards from the same stand only.

Forest: Alpha or numeric name of Forest, Park, Indian reservation, BLM, etc. Example F L A T H E A D

Stand or Area: Use compartment, subcompartment, and stand number, or drainage. Any combination of numeric or alpha characters that will identify the areas surveyed.

Examples 7 4 7 1 2 0 or R O C K C R E E K # 2

Survey code		Survey type
01	=	Bark beetle survey
02	=	Defoliator survey
03	=	Disease survey
04	=	Noninfectious disease survey

Observers: Names or initials of observers.

Type plot:

1 = Variable plot for trees >5" d.b.h. In addition, trees <5" are recorded on the 1/300-acre plot.

2 = Fixed plot for trees >5" d.b.h. In addition, trees <5" d.b.h. are recorded on the 1/300-acre plot.

Size plot: Enter BA factor or, 4 for ¼, 5 for 1/5 for fixed plots. Example of BAF 40 would be recorded as 4 0
or 1/5-acre fixed plot would be recorded as 0 5

Green tree plots: Enter number sampled plots where green tree data was recorded. If green tree data was recorded on all plots then green tree plots would equal total plots.

Total plots: Enter total number of plots used in sampling the stand including green stand plots. Include all plots even if some had no trees.

Plot cards

Ident code: Use same as header card. Example: 1 0 3

Plot: Plot number in sequence. Do not duplicate plot numbers within a stand. Example 0 1 for first plot.

HAB: Habitat type for plot. Use Montana valid habitat type numbers. Example: 5 2 1 for grand fir/Clintonia uniflora phase (appendix I)

Species: Use valid species code. Left adjusted. Appendix II.
Examples White pine , W P , ,
Larch , L , , ,

D.b.h.: Enter d.b.h. to nearest 1/10 inch, right adjusted. For example, a tree 12.3 inches in diameter is recorded as , 1 2 3 ,
Height: The height of trees sampled for height measurements is entered to the nearest foot, right adjusted.

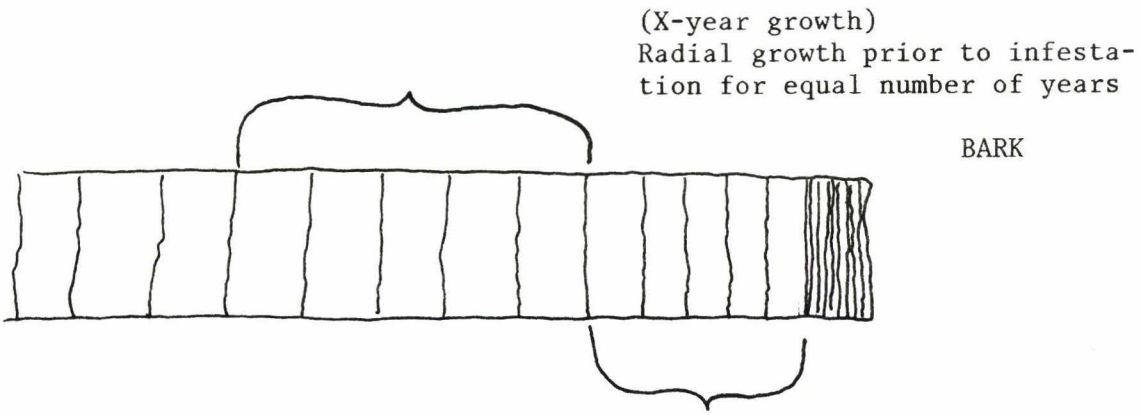
Age: or tree number if identity is needed. Age measurements are optional (to be added later to Program).

10-year growth: Last 10 years' radial growth in inches (two decimals assumed) right adjusted. Example of 1.05" 1 0 5
Example of .23" 2 3

Y-year growth: Radial growth measurements for the period of infestation. Not less than 2 years and not to exceed the last 10 years (two decimals assumed, right adjusted)

X-year growth: Radial growth measurement of the period of normal growth (two decimals assumed, right adjusted) (figure 3).

Figure 3


(X-year growth)
Radial growth prior to infestation for equal number of years
BARK
(Y-year growth)
Last 2-10 years radial growth
(period of infestation)

INSECT OR DISEASE CODES

Examine each tree and assign a damage code to each tree. Be sure to use the 0 code if no damaging agents are found. Use only valid codes (appendix III). The 0 code must be placed in first column (tree is undamaged). Do not place 0 in first column (40-41) and another code in second column (43-44).

INDIDS Deck Set Up for 2 Stands

A maximum of 99 stands can be run at one time. At present each stand has a limit of 365 sample trees if run on the CDC 3100 Computer at Missoula. Exhibit I shows examples of output from INDIDS.

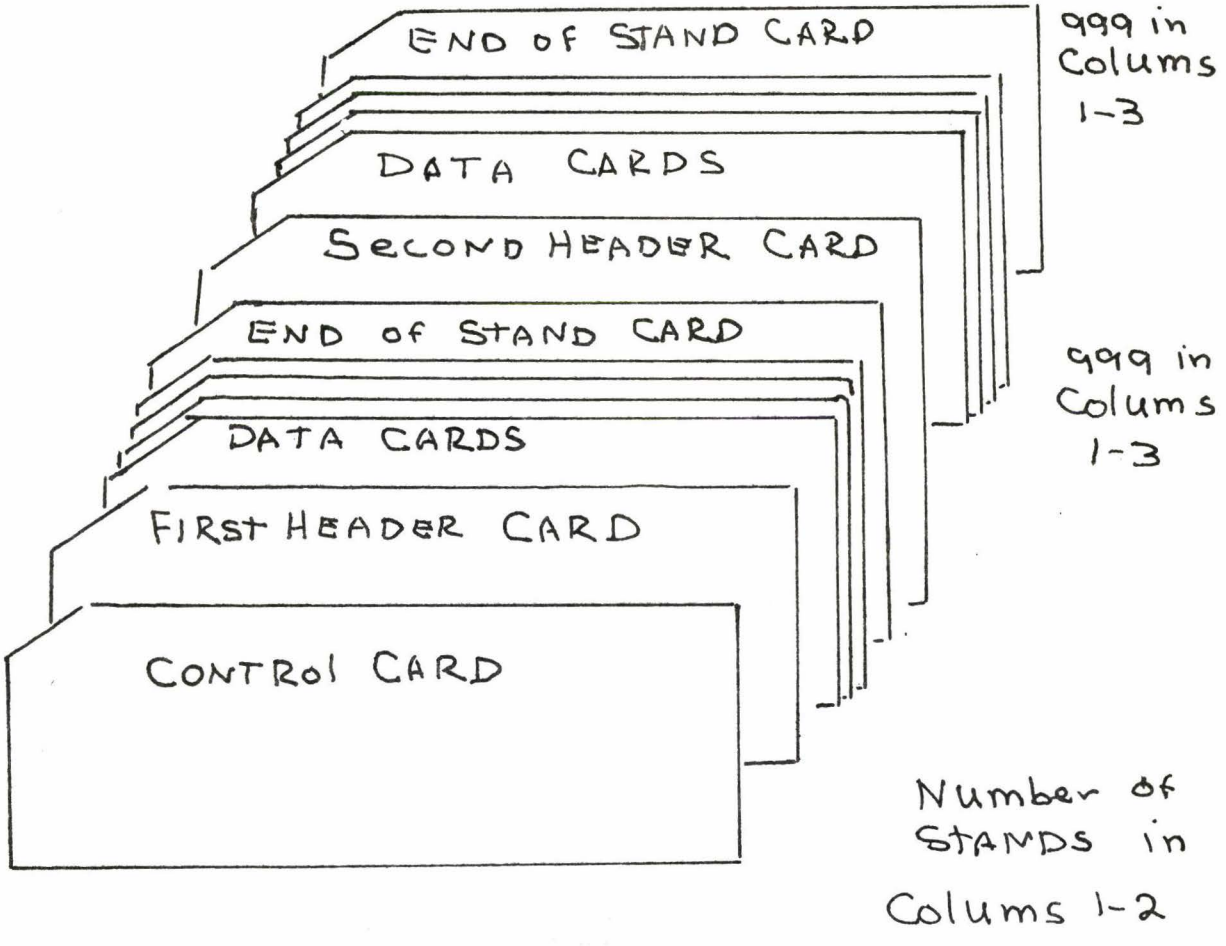


EXHIBIT I

BARK BEETLE SURVEY 9/21/78
---SPECIES LP ---

FLATHEAD WHALE CREEK 2 868

DIAMETER CLASS		GREEN STAND	CURRENT ATTACK	LAST YEARS	OLDER ATTACK	UNSUC. ATTACK	SEC. ATTACK	OTHER I+D PROB.	OTHER DAM. AGENTS	OTHER MORT.	TOTAL
	TA	150.00	0	0	0	0	0	0	0	0	150.00
	BA	.11	0	0	0	0	0	0	0	0	.11
0-4.9	CFA	0	0	0	0	0	0	0	0	0	0
	BFA	0	0	0	0	0	0	0	0	0	0
	APAI	0	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0	0
	TA	21.58	94.81	33.09	3.06	6.95	0	0	0	4.08	163.58
	BA	7.00	39.00	18.00	2.00	2.00	0	0	0	1.00	69.00
5-11.9	CFA	197.23	1157.42	555.83	68.64	54.19	0	0	0	25.04	2058.35
	BFA	156.90	2571.91	2462.69	332.80	0	0	0	0	0	5524.31
	APAI	0	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0	0
	TA	0	3.49	3.62	.95	0	0	0	0	0	8.06
	BA	0	3.00	3.00	1.00	0	0	0	0	0	7.00
12.0 +	CFA	0	102.04	98.23	35.66	0	0	0	0	0	235.93
	BFA	0	509.43	486.84	181.80	0	0	0	0	0	1178.07
	APAI	0	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0	0
	TA	171.58	98.31	36.71	4.01	6.95	0	0	0	4.08	351.64
	BA	7.11	42.00	21.00	3.00	2.00	0	0	0	1.00	76.11
TOTALS	CFA	197.23	1259.46	654.06	104.30	54.19	0	0	0	25.04	2294.28
	BFA	156.90	3081.35	2949.53	514.60	0	0	0	0	0	6702.38
	APAI	0	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0	0

TA = Trees per acre
BA = Basal area
CFA = Cubic ft. volume per acre
BFA = Board ft volume per acre

APAI = Actual periodic annual increment
EPAI = Expected periodic annual increment
(PAI) Cubic foot production per acre per year without damage

EXHIBIT I
(con.)

DEFOLIATOR SURVEY
---SPECIES TOTAL---

0/ 0/ 0

CLEARWATER WEST FORK SQUAW 104

DIAMATER CLASS		GREEN STAND	LIGHT DEF.	MODERATE DEF.	HEAVY DEF.	LIGHT TOP KILL	MOD. TOP KILL	HEAVY TOP KILL	DEF. MORT.	OTHER I+D PROB.	OTHER MORT.	OTHER DAM. AGENTS	TOTALS
	TA	393.75	0	18.75	18.75	56.25	0	0	0	0	0	0	487.50
	BA	1.23	0	1.18	1.89	2.76	0	0	0	0	0	0	7.06
0-4.9	CFA	0	0	0	0	0	0	0	0	0	0	0	0
	BFA	0	0	0	0	0	0	0	0	0	0	0	0
	APAI	0	0	0	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0	0	0	0
	TA	46.13	10.85	8.37	19.56	0	13.21	0	0	0	0	4.77	98.12
	BA	15.00	2.50	2.50	5.00	0	7.50	0	0	0	0	2.50	32.50
5-11.9	CFA	222.09	20.01	34.18	66.33	0	133.04	0	0	0	0	49.51	475.66
	BFA	476.77	0	0	0	0	442.97	0	0	0	0	145.31	919.74
	APAI	13.00	2.42	1.19	6.37	0	3.88	0	0	0	0	1.35	26.86
	EPAI	13.00	2.42	1.19	6.37	0	6.44	0	0	0	0	2.13	29.41
	TA	14.85	0	0	0	5.39	3.95	0	0	0	1.22	.44	25.85
	BA	35.00	0	0	0	12.50	7.50	0	0	0	5.00	5.00	65.00
12.5 +	CFA	1233.96	0	0	0	447.30	271.26	0	0	0	210.38	258.85	2421.74
	BFA	6865.20	0	0	0	2549.25	1477.45	0	0	0	1247.10	1393.33	13532.33
	APAI	20.38	0	0	0	5.82	3.52	0	0	0	0	2.31	32.04
	EPAI	20.38	0	0	0	8.38	5.31	0	0	0	0	2.31	36.38
	TA	454.72	10.85	27.12	38.31	61.64	17.17	0	0	0	1.22	5.21	611.47
	BA	51.23	2.50	3.68	6.89	15.26	15.00	0	0	0	5.00	7.50	104.56
TOTALS	CFA	1456.04	20.01	34.18	66.33	447.30	404.30	0	0	0	210.38	308.36	2897.40
	BFA	7341.97	0	0	0	2549.25	1920.42	0	0	0	1247.10	1538.64	14452.07
	APAI	33.38	2.42	1.19	6.37	5.82	7.41	0	0	0	0	3.66	58.90
	EPAI	33.38	2.42	1.19	6.37	8.38	11.74	0	0	0	0	4.45	65.79

ADP code[1]	Abbreviation	Habitat types and phases: Scientific names	Common names
010	SCREE		
000		PINUS FLEXILIS CLIMAX SERIES	
040	PIFL/AGSP h.t.	Pinus flexilis/Agropyron spicatum h.t.	limber pine/bluebunch wheatgrass
050	PIFL/FEID h.t.	Pinus flexilis/Festuca idahoensis h.t.	limber pine/Idaho fescue
051	-FEID phase	-Festuca idahoensis phase	-Idaho fescue phase
052	-FESC phase	-Festuca scabrella phase	-rough fescue phase
070	PIFL/JUCO h.t.	Pinus flexilis/Juniperus communis h.t.	limber pine/common juniper
100		PINUS PONDEROSA CLIMAX SERIES	
110	PIPO/AND h.t.[2]	Pinus ponderosa/Andropogon spp. h.t.	ponderosa pine/bluestem
130	PIPO/AGSP h.t.	Pinus ponderosa/Agropyron spicatum h.t.	ponderosa pine/bluebunch wheatgrass
140	PIPO/FEID h.t.	Pinus ponderosa/Festuca idahoensis h.t.	ponderosa pine/Idaho fescue
141	-FEID phase	-Festuca idahoensis phase	-Idaho fescue phase
142	-FESC phase	-Festuca scabrella phase	-rough fescue phase
160	PIPO/PUTR h.t.	Pinus ponderosa/Purshia tridentata h.t.	ponderosa pine/bitterbrush
161	-AGSP phase	-Agropyron spicatum phase	-bluebunch wheatgrass phase
162	-FEID phase	-Festuca idahoensis phase	-Idaho fescue phase
170	PIPO/SYAL h.t.	Pinus ponderosa/Symphoricarpos albus h.t.	ponderosa pine/snowberry
171	-SYAL phase	-Symphoricarpos albus phase	-snowberry phase
172	-BERE phase	-Berberis repens phase	-creeping oregon grape phase
180	PIPO/PRVI h.t.	Pinus ponderosa/Prunus virginiana h.t.	ponderosa pine/chokecherry
181	-PRVI phase	-Prunus virginiana phase	-chokecherry phase
182	-SHCA phase	-Shepherdia canadensis phase	-buffaloberry phase
200		PSEUDOTSUGA MENZIESII CLIMAX SERIES	
210	PSME/AGSP h.t.	Pseudotsuga menziesii/Agropyron spicatum h.t.	Douglas-fir/bluebunch wheatgrass
220	PSME/FEID h.t.	Pseudotsuga menziesii/Festuca idahoensis h.t.	Douglas-fir/Idaho fescue
230	PSME/FESC h.t.	Pseudotsuga menziesii/Festuca scabrella h.t.	Douglas-fir/rough fescue
250	PSME/VACA h.t.	Pseudotsuga menziesii/Vaccinium caespitosum h.t.	Douglas-fir/dwarf huckleberry
260	PSME/PHMA h.t.	Pseudotsuga menziesii/Physocarpus malvaceus h.t.	Douglas-fir/ninebark
261	-PHMA phase	-Physocarpus malvaceus phase	-ninebark phase
262	-CARU phase	-Calamagrostis rubescens phase	-pinegrass phase
280	PSME/VAGL h.t.	Pseudotsuga menziesii/Vaccinium globulare h.t.	Douglas-fir/blue huckleberry
281	-VAGL phase	-Vaccinium globulare phase	-blue huckleberry phase
282	-ARUV phase	-Arctostaphylos uva-ursi phase	-kinnikinnick phase
283	-XETE phase	-Xerophyllum tenax phase	-beargrass phase
290	PSME/LIBO h.t.	Pseudotsuga menziesii/Linnaea borealis h.t.	Douglas-fir/twinflower
291	-SYAL phase	-Symphoricarpos albus phase	-snowberry phase
292	-CARU phase	-Calamagrostis rubescens phase	-pinegrass phase
293	-VAGL phase	-Vaccinium globulare phase	-blue huckleberry phase
310	PSME/SYAL h.t.	Pseudotsuga menziesii/Symphoricarpos albus h.t.	Douglas-fir/snowberry
311	-AGSP phase	-Agropyron spicatum phase	-bluebunch wheatgrass phase
312	-CARU phase	-Calamagrostis rubescens phase	-pinegrass phase
313	-SYAL phase	-Symphoricarpos albus phase	-snowberry phase
320	PSME/CARU h.t.	Pseudotsuga menziesii/Calamagrostis rubescens h.t.	Douglas-fir/pinegrass
321	-AGSP phase	-Agropyron spicatum phase	-bluebunch wheatgrass phase
322	-ARUV phase	-Arctostaphylos uva-ursi phase	-kinnikinnick phase
323	-CARU phase	-Calamagrostis rubescens phase	-pinegrass phase
324	-PIPO phase	-Pinus ponderosa phase	-ponderosa pine phase
330	PSME/CAGE h.t.	Pseudotsuga menziesii/Carex geyeri h.t.	Douglas-fir/elk sedge
340	PSME/SPBE h.t.	Pseudotsuga menziesii/Spiraea betulifolia h.t.	Douglas-fir/white spiraea
350	PSME/ARUV h.t.	Pseudotsuga menziesii/Arctostaphylos uva-ursi h.t.	Douglas-fir/kinnikinnick
360	PSME/JUCO h.t.	Pseudotsuga menziesii/Juniperus communis h.t.	Douglas-fir/common juniper
370	PSME/ARCO h.t.	Pseudotsuga menziesii/Arnica cordifolia h.t.	Douglas-fir/heartleaf arnica
380	PSME/SYOR h.t.[2]	Pseudotsuga menziesii/Symphoricarpos oreophilus h.t.	Douglas-fir/mountain snowberry
400		PICEA CLIMAX SERIES	
410	PICEA/EQAR h.t.	Picea/Equisetum arvense h.t.	spruce/common horsetail
420	PICEA/CLUN h.t.	Picea/Clintonia uniflora h.t.	spruce/queencup beadlily
421	-VACA phase	-Vaccinium caespitosum phase	-dwarf huckleberry phase
422	-CLUN phase	-Clintonia uniflora phase	-queencup beadlily phase
430	PICEA/PHMA h.t.	Picea/Physocarpus malvaceus h.t.	spruce/ninebark
440	PICEA/GATR h.t.	Picea/Galium triflorum h.t.	spruce/sweetscented bedstraw
450	PICEA/VACA h.t.	Picea/Vaccinium caespitosum h.t.	spruce/dwarf huckleberry
460	PICEA/SEST h.t.	Picea/Senecio streptanthifolius h.t.	spruce/cleft-leaf groundsel
461	-PSME phase	-Pseudotsuga menziesii phase	-Douglas-fir phase
462	-PICEA phase	-Picea phase	-spruce phase
470	PICEA/LIBO h.t.	Picea/Linnaea borealis h.t.	spruce/twinflower
480	PICEA/SMST h.t.	Picea/Smilacina stellata h.t.	spruce/starry Solomon's seal
500		ABIES GRANDIS CLIMAX SERIES	
510	ABGR/XETE h.t.	Abies grandis/Xerophyllum tenax h.t.	grand fir/beargrass
520	ABGR/CLUN h.t.	Abies grandis/Clintonia uniflora h.t.	grand fir/queencup beadlily
521	-CLUN phase	-Clintonia uniflora phase	-queencup beadlily phase
522	-ARNU phase	Aralia nudicaulis phase	-wild sarsaparilla phase
523	-XETE phase	-Xerophyllum tenax phase	-beargrass phase
590	ABGR/LIBO h.t.	Abies grandis/Linnaea borealis h.t.	grand fir/twinflower
591	-LIBO phase	-Linnaea borealis phase	-twinflower phase
592	-XETE phase	-Xerophyllum tenax phase	-beargrass phase

(con.)

ADP code[1]	Abbreviation	Habitat types and phases: Scientific names	Common names
501		THUJA PLICATA CLIMAX SERIES	
530	THPL/CLUN h.t.	Thuja plicata/Clintonia uniflora h.t.	western redcedar/queencup beadlily
531	-CLUN phase	-Clintonia uniflora phase	-queencup beadlily phase
532	-ARNU phase	-Aralia nudicaulis phase	-wild sarsaparilla phase
533	-MEFE phase	-Menziesia ferruginea phase	-menziesia phase
550	THPL/OPHO h.t.	Thuja plicata/Oplopanax horridum h.t.	western redcedar/devil's club
502		TSUGA HETEROPHYLLA CLIMAX SERIES	
570	TSHE/CLUN h.t.	Tsuga heterophylla/Clintonia uniflora h.t.	western hemlock/queencup beadlily
571	-CLUN phase	-Clintonia uniflora phase	-queencup beadlily phase
572	-ARNU phase	-Aralia nudicaulis phase	-wild sarsaparilla phase
600		ABIES LASIOCARPA CLIMAX SERIES	
700		Lower subalpine h.t.s	
610	ABLA/OPHO h.t.	Abies lasiocarpa/Oplopanax horridum h.t.	subalpine fir/devil's club
620	ABLA/CLUN h.t.	Abies lasiocarpa/Clintonia uniflora h.t.	subalpine fir/queencup beadlily
621	-CLUN phase	-Clintonia uniflora phase	-queencup beadlily phase
622	-ARNU phase	-Aralia nudicaulis phase	-wild sarsaparilla phase
623	-VACA phase	-Vaccinium caespitosum phase	-dwarf huckleberry phase
624	-XETE phase	-Xerophyllum tenax phase	-beargrass phase
625	-MEFE phase	-Menziesia ferruginea phase	-menziesia phase
630	ABLA/GATR h.t.	Abies lasiocarpa/Galium triflorum h.t.	subalpine fir/sweetscented bedstraw
640	ABLA/VACA h.t.	Abies lasiocarpa/Vaccinium caespitosum h.t.	subalpine fir/dwarf huckleberry
650	ABLA/CACA h.t.	Abies lasiocarpa/Calamagrostis canadensis h.t.	subalpine fir/bluejoint
651	-CACA phase	-Calamagrostis canadensis phase	-bluejoint phase
653	-GATR phase	-Galium triflorum phase	-sweetscented bedstraw phase
654	-VACA phase	-Vaccinium caespitosum phase	-dwarf huckleberry phase
660	ABLA/LIBO h.t.	Abies lasiocarpa/Linnaea borealis h.t.	subalpine fir/twinflower
661	-LIBO phase	-Linnaea borealis phase	-twinflower phase
662	-XETE phase	-Xerophyllum tenax phase	-beargrass phase
663	-VASC phase	-Vaccinium scoparium phase	-grouse whortleberry phase
670	ABLA/MEFE h.t.	Abies lasiocarpa/Menziesia ferruginea h.t.	subalpine fir/menziesia
680	TSME/MEFE h.t.	Tsuga mertensiana/Menziesia ferruginea h.t.	mountain hemlock/menziesia
690	ABLA/XETE h.t.	Abies lasiocarpa/Xerophyllum tenax h.t.	subalpine fir/beargrass
691	-VAGL phase	-Vaccinium globulare phase	-blue huckleberry phase
692	-VASC phase	-Vaccinium scoparium phase	-grouse whortleberry phase
710	TSME/XETE h.t.	Tsuga mertensiana/Xerophyllum tenax h.t.	mountain hemlock/beargrass
720	ABLA/VAGL h.t.	Abies lasiocarpa/Vaccinium globulare h.t.	subalpine fir/blue huckleberry
730	ABLA/VASC h.t.	Abies lasiocarpa/Vaccinium scoparium h.t.	subalpine fir/grouse whortleberry
731	-CARU phase	-Calamagrostis rubescens phase	-pinegrass phase
732	-VASC phase	-Vaccinium scoparium phase	-grouse whortleberry phase
733	-THOC phase	-Thalictrum occidentale phase	-western meadowrue phase
740	ABLA/ALSI h.t.	Abies lasiocarpa/Alnus sinuata h.t.	subalpine fir/Sitka alder
750	ABLA/CARU h.t.	Abies lasiocarpa/Calamagrostis rubescens h.t.	subalpine fir/pinegrass
770	ABLA/CLPS h.t.	Abies lasiocarpa/Clematis pseudoalpina h.t.	subalpine fir/virgin's bower
780	ABLA/ARCO h.t.	Abies lasiocarpa/Arnica cordifolia h.t.	subalpine fir/heartleaf arnica
790	ABLA/CAGE h.t.[2]	Abies lasiocarpa/Carex geyeri h.t.	subalpine fir/elk sedge
791	-CAGE phase	-Carex geyeri phase	-elk sedge phase
792	-PSME phase	-Pseudotsuga menziesii phase	-Douglas-fir phase
800		Upper subalpine h.t.s	
810	ABLA/RIMO h.t.[2]	Abies lasiocarpa/Ribes montigenum h.t.	subalpine fir/mountain gooseberry
820	ABLA-PIAL/VASC h.t.	Abies lasiocarpa-Pinus albicaulis/Vaccinium scoparium h.t.	subalpine fir-whitebark pine/grouse whortleberry
830	ABLA/LUHI	Abies lasiocarpa/Luzula hitchcockii h.t.	subalpine fir/smooth wood-rush
831	-VASC phase	-Vaccinium scoparium phase	-grouse whortleberry phase
832	-MEFE phase	-Menziesia ferruginea phase	-menziesia phase
840	TSME/LUHI h.t.[2]	Tsuga mertensiana/Luzula hitchcockii h.t.	mountain hemlock/smooth wood-rush
841	-VASC phase	-Vaccinium scoparium phase	-grouse whortleberry phase
842	-MEFE phase	-Menziesia ferruginea phase	-menziesia phase
890		Timberline h.t.s	
850	PIAL-ABLA h.t.s	Pinus albicaulis-Abies lasiocarpa h.t.s	whitebark pine-subalpine fir
860	LALY-ABLA h.t.s	Larix lyallii-Abies lasiocarpa h.t.s	alpine larch-subalpine fir
870	PIAL h.t.s	Pinus albicaulis h.t.s	whitebark pine
900		PINUS CONTORTA CLIMAX SERIES	
910	PICO/PUTR h.t.	Pinus contorta/Purshia tridentata h.t.	lodgepole pine/bitterbrush
920	PICO/VACA c.t.	Pinus contorta/Vaccinium caespitosum c.t.	lodgepole pine/dwarf huckleberry
930	PICO/LIBO c.t.	Pinus contorta/Linnaea borealis c.t.	lodgepole pine/twinflower
940	PICO/VASC c.t.	Pinus contorta/Vaccinium scoparium c.t.	lodgepole pine/grouse whortleberry
950	PICO/CARU c.t.	Pinus contorta/Calamagrostis rubescens c.t.	lodgepole pine/pinegrass

Total Number of Habitat Types = 64

Total Number of Habitat Types, Phase, and Pinus contorta Community Type Categories = 105

[1] Automatic data processing codes for National Forest System use.
[2] Minor type in Montana; described in other study areas.

APPENDIX II

Species Codes

GF = Grand fir
AF = Subalpine fir
J = Juniper
L = Larch
S = Spruce
WLP = White bark or limber pine
LP = Lodgepole pine
WP = Western white pine
PP = Ponderosa pine
DF = Douglas-fir
Y = Yew
C = Western redcedar
WH = Western hemlock
MH = Mountain hemlock
B = Birch
ASH = Ash
CW = Cottonwood
ASP = Aspen
OH = Other hardwoods
AL = Alpine larch

APPENDIX III

Damage Codes

Code	
0	Healthy tree, no insect, disease, or damage problem
1	Unknown or natural mortality

Bark Beetles

2	Current beetle attack
3	Last year's attack
4	Older beetle attack
5	Unsuccessful attack
6	Secondary or other bark beetle attack

Defoliation

7	Light defoliation (less than 10%)
8	Moderate defoliation (10-70%)
9	Heavy defoliation (greater than 70%)
10	Light top kill (less than 10% top dead from repeated defoliation)
11	Moderate top kill (10-33% top dead)
12	Heavy top kill (greater than 33% dead top)
13	Defoliator mortality (mortality caused by defoliators only)

Disease

14	Mistletoe infected
15	Mortality from mistletoe
16	Root rot
17	Mortality from abiotic causes

Noninfectious Disease

18	Light damage
19	Moderate damage
20	Heavy damage
21	Mortality from abiotic causes
22	Other damaging agents (fire scar, lightning, old spike top, etc.)

FIGURE 2
FOREST INSECT AND DISEASE DAMAGE SURVEY

Ident. code 103 (1-3)

Forest FLATHEAD (4-19)

Slope 30 Aspect NE Elev 4½

Stand or Area 747.4.120 (20-35)

Type plot 1 (69)

Physo Site 6

Survey code 01 (36-37)

Size plot 20 (70-71)

Hab 740

Type BARK BEETLE (38-51)

Observers JONES & SMITH (52-66)

Soil

Green tree plots 10 (67-68) Total plots 20 (72-74) Date 9 4 77 (75-76) (77-78) (79-80)

Ident. code (1-3)	Plot (5-6)	HAB (8-10)	Species (12-14)	D.b.h. (16-18)	Height (20-22)	Age (24-26)	10-yr. growth (28-30)	5 yr (32-34)	X yr (36-38)	Insect or disease codes (40-41)	(43-44)	(46-47)
103	01	740	LP	128	89	ONLY DAMAGED				2		
	01	"	LP	142	91	TREES RECORDED				4	22	
						ON THIS PLOT						
	02	740	LP	122	81	RECORD DATA				0		
			LP	68	58	ON ALL TREES				2		
			LP	143	89	THIS PLOT				3		
			AF	62						0		
			DF	89						7	16	22
			LP	168						2	14	
			LP	41		TREES ON				0		
			AF	1		1/300 ACRE				0		
			AF	1		PLOT				0		
	03					NO DAMAGE TREES						
						ON PLOT						
	04	740	LP	108	78	RECORD DATA				0		
			LP	126	85	ON ALL TREES				14	2	
			AF	86	61	THIS PLOT				22		
			AF	89						0		
			DF	142						9	22	
			LP	41		TREES ON				0		
			AF	1		1/300 ACRE				0		
						PLOT						

FIGURE 2, con.

CONTINUATION SHEET

FOREST FLATHEAD

STAND 747 4 12C

FOREST INSECT AND DISEASE DAMAGE SURVEY

Ident. code (1-5)	Plot (5-6)	HAB (6-10)	Species (12-14)	D.b.h. (16-18)	Height (20-22)	Age (24-26)	10-yr. growth (28-30)	(32-34)	(36-38)	Insect or disease codes (40-41)	(43-44)	(46-47)
103	05	740	LP	89	68	RECORD DAMAGED				3		
			LP	103	71	TREES				4		
			AF	92	62					9		
			LP	31	}	1/300 ACRE Plot				1		
			AF	21	}					9		
103	06	750	DF	168	89	RECORD DATA				7	11	22
			LP	142	82	ON ALL TREES				0		
			LP	92	71	IN THIS PLOT				0		
			LP	168						4		
			DF	81	}					0		
			AF	21	}	1/300 ACRE PLOT				1		
			AF	1						0		
			AF	1						0		
				CONTINUE								